

# FINAL EVALUATION REPORT

## THE SUSTAINING CLEANER AND HEALTHIER ENVIRONMENT IN THE KITCHEN IN KENYA AND MARKET ACCESS TO CLEAN COOKING ENERGY FOR HEALTH AND WEALTH IN KENYA (USEPA PROJECT)

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*Photo showing the installation of a smoke hood by two installers in one the households in Kadibo division.*

August 2011

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<sup>1</sup> USEPA quarterly report- July 2010



## ACRONYMS AND ABBREVIATIONS

CBO-Community Based Organisation

CO- Carbon Monoxide

CHW- Community Health workers

GOK-Government of Kenya

MoPH-Ministry of Public Health

NGO- Non Governmental Organisations

PA- Practical Action

SCI- Solar Cookers International

SCOREP- Solar Cookers Representatives

SPSS-Statistical Package for Social Sciences

USD- United States Dollars

USEPA-United States Environmental Protection Agency

VSL- Village Savings and Loan

WHO- World Health Organisation

## ACKNOWLEDGEMENT

The Apptech consultancy team would like to acknowledge both individual and institutional effort, collaboration and technical commitment that culminated into this manuscript. At the institutional level, much appreciation goes to Solar Cookers International (SCI) and Practical Action (PA) whose commitment ensured design, facilitation and implementation of the end project evaluation study. This appreciation cannot be complete without the mention of dedicated partners including relevant GOK departments like Provincial Administration (Chiefs and their assistants), MoPH, Ministry of Agriculture, CBOs, NGOs and communities that are the cornerstone of development activities in Kadibo Division.

At individual level, we would like to commend specific SCI and PA's staff for the effort and time they devoted in the whole process. Sincere gratitude is extended to [redacted] project manager Practical Action-USEPA project in Kadibo, [redacted] Project Manager-USEPA (SCI) and [redacted] project assistant at Practical Action whose planning prowess enabled successful completion of the critical evaluation components. It is our great pleasure to acknowledge invaluable technical backstopping received from Solar Cookers International Regional Director [redacted] and Practical Action National Office M&E in-charge, [redacted].

Finally, we would like to thank Kadibo community for their cooperation and moral support, especially household members, school teachers and pupils, staff of NGOs and CBOs, government officers, and other stakeholders who humbly accepted and provided relevant information that facilitated the usefulness of the evaluation study. We humbly appreciate their contributions and acknowledge that this study would have not been successful without their invaluable input.

### Evaluation Team:

The Evaluation team of USEPA project was undertaken by Apptech Consulting Services, based in Kisumu. The evaluation team consisted of;

- [redacted] Nan Ong'or Lead Consultant, Renewable Energy Technology Promotion expert
- [redacted] Dr. Paul Abum Environmental scientist
- [redacted] Margaret Oden Community saving and loan/cooperative expert

It also included a team of seven enumerators some of whom were recruited from the community.



## EXECUTIVE SUMMARY

The Sustaining Cleaner and Healthier Environment in the Kitchen in Kenya and Market Access to Clean Cooking Energy for Health and Wealth in Kenya (USEPA project) addressing Indoor Air Quality and Living Environment in the Kitchen has been implemented in Kadibo Division, Kisumu East District of Kenya. The project was a partnership of two organizations, Solar Cookers International- SCI (EA) and Practical Action (EA). The two partners were funded mainly by United States Environmental Protection Agency (USEPA) at a cost of USD 300,000. However, the project received a further co-funding of USD 80,000 from SCI that supported some implementation activities of SCI(EA). The USEPA project began in January 2009 and ended in May 2011.

The purpose of the project was to transform the socio-economic and health conditions of low income households through public education, scaling up, wider use, and uptake of improved and clean cooking technologies and to create market mechanisms for production, marketing and dissemination of efficient and improved smoke reducing interventions in Kadibo Division. The project goals for each of the two implementers were<sup>2</sup>;

- Expand the marketing and sales network for solar cookers, Upesi stoves and retained heat cookers
- Strengthen local access to smoke reducing cooking technologies that complement solar cookers
- Reach at least 3000 households by the end of the project period

### The specific objectives of the project were;

- i) To increase the level of understanding, knowledge, education and attitude change among communities in Kadibo Division on the impact of smoke on the health of mothers and children.
- ii) To strengthen local access to and promote the uptake of existing efficient smoke reducing technologies.
- iii) To strengthen the capacity of producers, installers to provide quality smoke reduction and fuel saving interventions and services.
- iv) Expand marketing and sales network for smoke reducing products and services.
- v) To influence policy dialogue and review to incorporate household indoor air quality as one of the public health requirements.
- vi) Reach at least 6,000 households with the interventions as follows;
  - 5% - of households should own at least 5 interventions.
  - 10% - 4 - interventions.
  - 15% - 3 - interventions.
  - 40% - 2 - interventions.

The target number of beneficiaries of 6000 households were to be reached with the improved smoke reduction interventions as well as none smoke technologies like solar cookits by a joint intervention by both SCI and Practical Action.

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<sup>2</sup> SCI(EA)-Quarterly Report, May 2011

To achieve its purpose and objectives the project aimed at developing the household energy sector that could substantially reduce the high levels of indoor air pollution. It also aimed at reduction in greenhouse gases emissions through large scale use of solar energy and improved biomass stoves and kitchen interventions. The study also identified the relationship between energy use in households, indoor air pollution and the resulting health problems, and the gender considerations in the indoor air pollution management.

To determine the extent to which the objectives were achieved, the study employed the use of survey design and used both qualitative and quantitative methods of data collection. The total survey sample size was 318 households, 46 households were non targeted in the project and acted as control to assist in arriving at the conclusions. A household survey, Key Informant Interviews and Focus Group discussions were used for data collection. Other methodologies used were review of secondary data including project reports, observations and photography. Smoke measurements were carried out using the *Gas Badge pro* Instrument. Smoke measurements were carried out on a 48 hour schedule within the beneficiaries kitchens. The SPSS version 12 was used to carry out statistical analysis of the results

The USEPA project engaged in creation of Village Saving and Loaning groups to empower the beneficiaries especially women who were majority participants. Also develop global and national linkages of the project to policy implications. A linkage between the national energy policy and IAP was assessed and possible ways to surmount emerging environmental health challenges to household energy and achievement of the project objectives for sustainability was assessed.

The project used an innovative approach of integrated technology promotion combining solar CookKits that depends on sun's energy source and biomass stove technologies as well as provision of eave spaces and hay baskets. The implementation process has integrated a business approach and has emphasized awareness creation on effects of smoke among the communities.

### **The Findings:**

- The main source of livelihood for the community in Kadibo division is subsistence farming (47%) which includes growing crops and keeping livestock. These are supplemented with petty trade and provision of unskilled labour within the neighborhood.
- Less than half of the population (46.2%) of the respondents could read easily, 25.2% with difficulty, 28.6% could not read at all while 16.4% of the respondents had never gone to school or had no formal education. About 53% had gone through formal education and either completed lower or upper primary level of education, 23.4% had completed secondary level of education. Only 4.2% of the respondents had attained post secondary level of education.
- The awareness level on the dangers of smoke and smoke reduction interventions by USEPA project is at 91% for the households in Kadibo Division. For these respondents who are aware of the project, 34.2% received information from Solar Cookers International, 29% from Practical Action, 5.9% from chiefs, 2.6% from Ministry of Health and Ministry of Agriculture provided information to 1.8% of the households while those who received the information from other sources represented 26.5%.



Awareness levels were enhanced through culturally popular methods. For example, the use of songs to inform people on dangers of kitchen smoke, informing people of benefits of solar cookKits, Upesi stove or smoke pollution reducing interventions during public meetings.

- In order to improve knowledge on effects of smoke and role of efficient cooking technologies in improved kitchen hygiene, several awareness strategies were employed. These included public and group demonstrations, radio programs, posters, songs and dances, T-shirts, drama and Community Theater, group meetings and flyers distribution were employed. Door to door campaign was a channel used to create awareness but it proved to be expensive and was also hindered by floods during the rainy season in Kadibo Division.
- From the smoke measurements and monitoring carried out during the evaluation, there appeared to be high levels of carbon monoxide in the kitchens in the evening cooking period as compared to lunch hour and morning cooking periods, for the households that did not have any interventions, when compared to the households that had at least the minimum effective interventions. This is a reflection of the low level of ventilation or low ability of smoke to escape from the kitchens without improved ventilation at such times. The eave spaces are not adequate to allow easy escape of un- burnt gases.
- The division comprised of 61,326 individuals and female make up to 52.3% of the population. The study polled 318 households of which 46 were not adopting the IAP technologies. Most households were male headed, however, of the households visited, 96.3% of the respondents were women, an indication that majority of those who were involved in this project were female.
- This posed challenges in the project implementation since women are economically vulnerable individuals in this community and they hardly earn anything substantial to adequately empower them to meet finances required to purchase stoves. However, this project tried to deal with the issue of economic vulnerability among the installers who are mainly women by setting up Village Savings and loaning (VSL) groups.
- Eight VSLs with an average membership of 20 persons have been established in the division. These provided funds to installers inform of credit and made them able to acquire stoves, install and be paid for their services. The approach is a promising undertaking and has the potential of sustaining the project activities.
- The Village Savings and Loaning groups have grown in strength in terms of participation and fund collections which reflect a desire to save for investment or future use. Individuals save an average of U.S \$ 11(KShs.1000) per month. These savings groups are in the process of formalization. The groups have been linked through information sharing to Micro finance institutions such as Faulu Kenya. As many people install and adopt the use of these devices in their kitchen, the installers keep deriving their livelihood from such activities.
- There is notable change in attitude towards the use of smoke reduction technologies. The community appreciates the roles of eave spaces in reducing smoke pollution in their kitchens. The smoke measurements ranged from 2ppm to 8ppm for carbon monoxide average measurements. This was realized since the installation of some IAP reduction



appliances for example Upesi Jiko has moved from 75% to 90% in uptake. Attitude change has also been observed in the savings and loaning culture of the community.

- 81.6% of users of smoke reduction technologies bought the IAP reduction interventions appliances, 9.6% of the users received the interventions as donations from the partners in the USEPA project while 5.1% received the devices in form of gifts from relatives, sons, daughters and friends. About 6.6% of the users acquired the interventions from other sources. The other sources of acquiring the devices were through institutions that include churches and Center for Disease Control (CDC), an international organisation that is locally involved in health research. They gave out some devices and interventions especially Upesi stove.
- The survey results indicated that 54.1% of the respondents attributed prevalence of respiratory diseases in the area to too much smoke in the house during preparation of meals while 43.4% ascribed the high incidence to too much dust. It was also noted that climatic and weather changes could be blamed for high disease prevalence in the area as indicated by 44.7% of the respondents; however, 9.1% did not know the major contributors to high prevalence of these diseases. Information available from the public health department at the local Rabuor health center showed that Acute Respiratory infections are second ranked after malaria as the most prevalent disease among adults in Kadibo division while in children under 5 years Upper respiratory infections are also ranked second in prevalence after malaria<sup>3</sup>.
- The main stove distributors and suppliers in the area are installers as shown by 79.6% of the respondents. This was followed by the SCOREPS and location leaders at 7.8%, while the project offices supplied only 1.1% of the households that benefited from the stove installation. However, SCI project office was the main supplying project office.
- On expanding marketing and sales network, the results showed that 88.6% of households in the area knew the existence of a market linking IAP technologies and local users in their villages. Also 89.2% of the respondents agree that market network has been developed in the area for IAP technologies.
- From the national policy front, the study found out that the project was within the Ministry of Energy policy framework and mandate of facilitating the provision of clean, secure, sustainable and affordable energy services for social-economic development while protecting the environment. At the regional and local level, 13 radio dialogue sessions were held on the dangers of smoke where the project staff and ministry of public health officials participated in radio discussions. This resulted into more awareness as an estimated 3 million people were reached. Also a google groups network website has been initiated for blogging. Members are being recruited in the network even though the recruitment is slow. The home page is; [http://groups.google.com/group/kitchen\\_smoke](http://groups.google.com/group/kitchen_smoke).<sup>4</sup> This network helps discuss and share information on kitchen smoke-the silent killer and can influence policy.

<sup>3</sup> One on One discussion and report of the Divisional Public Health Officer, [REDACTED] July 2011

<sup>4</sup> Project Report for USEPA, SCI(EA)



- The project reached a total of 5714 households with smoke reducing interventions<sup>5</sup>, that is, 95.3% of the targeted number of households that were intended to be reached by the project. Furthermore the findings of the study among the 272 households with interventions show that at least 41% of those who adopted the IAP reduction technology had more than one intervention, 21% had at least two interventions, 13% had at least three interventions, 5% had at least four and 2% had five interventions. Most of the users had Upesi stove as the single most common intervention.

In conclusion, despite the ratio of trained installers to the number of households has increased from 387 households per installer to 140 households per installer. Also more than 90% of the target group adopted the existence of challenges, the project is successful in that more than 91% of the residents are aware of dangers of smoke within the project area and more people have been reached outside project area through demonstrations and radio talks.

Furthermore awareness has been created in schools that will create sustainability in knowledge transfer at the local level.

Local access and uptake of existing technologies has been improved. at least two IAP reducing technologies. Although adoptions of some IAP technology devices were dwindling, most of the devices had been installed by the households who were participating in the project. The slow adoption of some of these devices was attributed to attitude which is one of the human attributes that need a bit of time to change.

The savings and entrepreneurship culture has been developed in the division with the establishment of at least eight Village Savings and Loan groups with an average membership of 20 persons. This indicates the improvement in the capacity of individuals to start and sustain income generating activities.

In order to ensure that the project matures to a stage when the IAP reduction technology appliance are fully accepted, the implementation could have been sustained by ensuring that the exit strategy have the government departments and other actors prepared through engagement in project activities in a deliberate effort to influence their activity work plans so that they take over from SCI and PA and educate households on the need to reduce indoor pollution by use of efficient cooking appliances and construction of eave spaces.

#### **The recommendations from the study findings are;**

- That the projects' scale up activities should include writing and publication of children books both at national and local levels to increase knowledge on effects of smoke pollution in the kitchen. Such a publication will also improve knowledge on roles of fuel efficient stoves in reducing carbon monoxide levels in the kitchen. This strategy would also help influence policy and curriculum content especially at the primary school level and will ensure widespread knowledge on dangers of smoke and the interventions for reducing it beyond the project area and beyond gender barriers.
- An integrated approach that incorporates community training on livelihood diversification and quality stove production and marketing would be necessary so that individuals would recognize stove production and marketing as new source of livelihood.

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<sup>5</sup> USEPA project- 8<sup>th</sup> Quarterly reports

- The project should be replicated in other regions especially those that suffer extremes of weather such as flooding in Nyando division and drought prone areas since in extreme weather they lack properly prepared fuel wood and have limited access to clean fuels that can be a source of indoor air pollution.
- Since organizations would normally have different management styles and cultures, it would be necessary that in future if two or more organizations are to implement a stove technology focused project together, then the implementation strategy and quality controls must be well defined and explained so that each organization know exactly which specific objective to implement. This can be facilitated by setting up a joint project implementation committee that meets regularly.
- Whereas the exit strategy has ensured that some VSLs are formed for capital accumulation and marketing of the interventions by entrepreneur, these institutions should be made aware of importance of registration with relevant government ministries so as to be recognized as entities.
- The project implementation team outsourced external expertise from other partners to build a saving culture among the project beneficiaries. However, such partners were not initially enjoined in the project implementation process as is the case for Vi Agroforestry. The project should have planned activities for capacity development of its staff so as to enhance their skills to train and mentor community members in savings and entrepreneurship culture. This consideration would be important in a scale up of the project
- Whereas the policy agenda for the project was to participate in the periodic District Environment Consortium meetings and to meet with district health management board, the meetings were never held as the project prioritized field work<sup>6</sup>. It is therefore recommended that the project activities could be extended to allow the implementers to make further contributions in a policy development process for kitchen smoke reduction. The Ministry of housing could also be engaged in policy discussions to help influence house design requirements so that eave spaces are installed in all households.

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<sup>6</sup> USEPA quarterly report, October, 2010-SCI



## 1.0 BACKGROUND OF THE PROJECT

At the beginning of the project, baseline information showed that lack of knowledge on how to use kitchen smoke reducing interventions accounted for 39% in responses expressed by the entrepreneurs. It was noted that not everyone knew about the smoke reducing interventions. For example, the smoke hoods were not moving in the market because they were only accessed from the smoke hood artisans. Low levels of awareness were mentioned as a setback in some areas at the beginning<sup>7</sup>. This indicates that in those regions people were not aware of the interventions and even how to use them.

The project targeted Millennium Development Goals number one, four, five, seven and eight on ending poverty, improved child and maternal health, environmental sustainability and global partnership. The contribution of biomass energy as domestic cooking fuels in local Kenyan households and its importance for the renewable energy sector is recognized in current government policies. The Kenyan Vision 2030 recognizes the potential role of renewable energy technologies in contributing towards achievement of the industrialization process. These energy resources include solar energy, biomass, hydropower and biogas among others. The use of biomass for indoor cooking and heating exposes a family of men, women and children to smoke pollution. The linkage between energy use in households, indoor air pollution, and resulting health problems is already established (BP,57)<sup>8</sup>. However, there is lack of knowledge on the seriousness of problems caused by smoke pollution.

The project aimed to transform the socio-economic and health conditions of low income households through public education, scaling up, wider use, and uptake of improved and clean cooking technologies and to create market mechanisms for production, marketing and dissemination of efficient and improved smoke reducing interventions.

Within the project goals it was presumed that a potential market exists within the household energy sector in the division and that expansion of the market and sales network for both solar cookers and Upesi stoves guaranteed a mix of technologies which could substantially reduce the high levels of indoor air pollution. It also aimed at reduction in greenhouse gas emissions resulting from large scale use of solar energy and improved biomass stoves and kitchen interventions. A linkage between the national energy policy and Indoor Air Pollution (IAP) was assessed during implementation and possible ways to surmount emerging environmental health challenges to household energy and achievement of the project objectives for sustainability was facilitated through policy dialogue.

The Sustaining Cleaner and Healthier Environment in the Kitchen in Kenya and Market Access to Clean Cooking Energy for Health and Wealth in Kenya (USEPA Project) addressing indoor air quality and living environment in the kitchen was implemented in Kadibo Division, Kisumu East District of Kenya by two organizations, Solar Cookers International- SCI (EA) and Practical Action (EA). This project was started in January 2009 and ended in May 2011.

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<sup>7</sup> Entrepreneurs survey report-Practical Action, 2008

<sup>8</sup> Boiling Point Journal, Number 57



Kadibo division is one of the divisions in Kisumu East district within Kisumu County of Nyanza province in Kenya. According to the year 2009 population census, the division had a population of 61,326 persons comprised of 12,994 households. Of this population 32,074 were females. The division lies in a lowland surrounding the Nyanza Gulf, at the tip of which is Kisumu Town. East of Kisumu town are the Kano Plains occasionally broken by the low ridges and rivers.

According to the last Kisumu East District Development plan(2008-2012)<sup>9</sup>, the dependency ratio stood at 100: 107. Thus every 100 workers were supporting 107 (one hundred and seven) dependence. The high dependency was expected to prevail in the current period and, which would subsequently affect per capita income and employment opportunities in the area. In the report, the forestry resource potential has been described to comprise of bushes and shrubs which occupy 20% of the land area. There are many tree species, notably *Acacia Seyal*, *Eucalyptus spp.* and *Cassia spp.* These trees and agricultural residues form the main sources of biomass cooking fuel resources in the division. According to the plan only 10% of the households in the entire district with 84963 households were using Solar energy. This indicates the need for improved efficient smoke reducing cooking technologies.

During the project period, the target number of beneficiaries was 6000 households that were to be reached with efficient and improved smoke reduction interventions; Solar cook kits, Upesi stove, Uhai Jiko, smoke hoods, Eave spaces as well as other technologies in a joint intervention by both SCI and Practical Action. At least 5% of households were expected to own at least 5 interventions at end of project, 10% with at least 4 interventions, 15% with at least 3 interventions and 40% with at least 2 interventions.

The project targeted an increase in the level of understanding, knowledge, education and attitude change among communities in Kadibo Division on the impact of smoke on the health of mothers and children. This was to be achieved through several awareness strategies that include public and group demonstrations, group meetings and flyers distribution were employed.

In order to strengthen local access to and promote the uptake of existing efficient smoke reducing technologies the project targeted the capacity building of existing stove producers to improve quality and production levels. *Bed gi Kwe* stove producing women group was trained on production and marketing of Upesi and Uhai stoves. This group produces stoves within the division. This group was mentored and trained by skilled trainers from Keyo Women group, a Kenya Bureau of Standards (KbS) certified producers for the KCJ, and Upesi Jiko.

At the beginning of this project, these stove and intervention distribution channel did not exist in the division. The project intended to strengthen the capacity of producers, installers to provide quality smoke reduction and fuel saving interventions and services.

The quality of their work was to be maintained through a rigorous quality control mechanism which was to involve the development of a quality control score sheet. The quality was to be

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<sup>9</sup> Kisumu East District Development Plan,2008-2012; Ministry of State for Planning, National Development and Vision 2030, June 2009



strengthened within the distribution channel comprising SCOREPS, Location leaders, Installers, stockists and fixed selling shops.

The project targeted a reduction in the smoke pollution levels in the kitchens. This was to be achieved through increased awareness on dangers of smoke to human health and uptake of smoke reducing technologies and interventions by the households. A baseline report has shown average smoke levels of about 8.99 ppm of Carbon monoxide(CO) in the kitchens<sup>10</sup>. Carbon monoxide is an odorless, colorless and toxic gas. At lower levels of exposure, CO causes mild effects that are often mistaken for the flu. These symptoms include headaches, dizziness, disorientation, nausea and fatigue. The effects of CO exposure can vary greatly from person to person depending on age, overall health and the concentration and length of exposure. The World Health Organization (WHO) maximum limit for carbon monoxide is 10 ppm - 20 ppm for an 8-hourly average time of exposure<sup>11</sup>.

During the project lifecycle, a marketing structure and strategy for supporting the uptake of smoke reducing technologies and improve the impacts of actions for smoke reduction in households was to be established. This effort was to assist expand marketing and sales network for smoke reducing products and services. At least eight Village Savings and Loan groups were formed and which continue to bring individual groups together. These are mainly women groups that undertake table banking and lending to members. It was expected that capital accumulated by individuals in this effort could come along way in supporting their entrepreneurial initiatives and purchase of interventions. It was one strategy of ensuring that the project becomes sustainable.

In order to influence policy dialogue, the project intended to engage policy implementers and policy makers from relevant government departments and institutions and to carry out reviews, education and meetings to incorporate household indoor air quality as one of the public health requirements. This could be achieved through meetings, forums and radio talks among others.

The USEPA project hired consultancy services of Apptech Consultants to carry out end of project evaluation survey in order to establish project achievements, challenges, sustainability and lessons learnt during the three-year project implementation period. The study was conducted between July and August 2011 in Kadibo Division.

### **1.1 The Scope of the evaluation and it's specific objectives**

This evaluation was designed to provide an independent external assessment of the USEPA project. It was designed to assess the progress of the project vis-à-vis the expected progress as per the project design objectives. This was a process of evaluation in which much concern was put on assessing achievements vis a vis intended outputs.

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<sup>10</sup> Researching pathways to scaling up sustainable and effective kitchen smoke alleviation: Smoke, health and household energy-Volume 2;Edited by Liz Bates; Practical Action

<sup>11</sup> World Health Organisation(2011). Indoor Air Pollution. [www.who.int/indoorair](http://www.who.int/indoorair)

The evaluation was to determine the effects of the project on individuals, households and in partnership for collaborative implementation of a smoke reduction project in households. It was also to identify the changes the project beneficiaries realized during its life, examine the strengths and weaknesses of the strategies used by the project to deliver the expected outcomes and their sustainability. It was also expected to carry out a measurement of the extent of reduction of Indoor Air Pollution in households in project area.

The evaluation was expected to review the factors affecting dissemination and uptake of various efficient energy saving interventions by category. The process comprised of analysis that was done from varied methodological approaches and sources. The innovativeness and relevance of the project as well as strengths, challenges and weaknesses in the design and implementation has been analyzed.



## **2.0 THE METHODOLOGY**

### **2.1 The overall study design**

The study employed the use of a multi-sectoral participatory and observational approach involving both qualitative and quantitative methods of data collection. The broader methodological aim was to carry out the study in the context of situation analysis of socio-economic levels of the community, indoor air pollution levels and knowledge in IAP control.

A participatory process was used to understand the types of stoves and interventions used in the households and the poverty framework. The participatory process ensured that learning is enriched from diverse households in their social and environment context. These approaches focused on assessing the intended outcomes of the project including measurements of carbon monoxide levels in the kitchen of beneficiaries. There were 318 respondents/households out of which 46 were from households with no interventions and 272 had interventions.

The study focused on four thematic areas namely;

- i) Detailed analysis of available secondary data including baseline reports, progress and activity reports;
- ii) Area mapping in the context of identifying households that own quality and tested fuel saving and smoke reducing technologies and other IAP interventions;
- iii) Participatory market structure analysis for the cooking devices and interventions
- iv) Analysis of institutional roles in policy advocacy and implementation of indoor air pollution for various institutions

### **2.2 Study area**

Kadibo division is one of the two administrative divisions in Kisumu East district. The divisional headquarters is easily accessible by road transport and lies on the main Kisumu- Nairobi road. The division is traversed by many seasonal rivers and irrigation canals which make it suffer from flooding in rainy seasons. It is bordered by Lake Victoria to the south, Kisumu town to the North West and Nyando division to the East.

According to the 2009 Kenya Population and Housing Census, Kadibo division had a population of 61,326 persons of which 32,074 were females. The division had 12, 994 households occupying an area of 164.8 kilometer squared. The division comprises of eight location administrative units.

### 2.3 Sampling technique

For accuracy and inclusiveness in sampling, the study used simple random sampling as the main sampling technique to identify the households that have the IAP interventions. The overall sample size for the study population will be calculated using the Fischer's et. Al., (1998) and Mugenda and Mugenda(2003) method as shown below:

$$nf = \frac{n}{(1 + n) / N}$$

Where:

$n$  = the desired sample size (if the target population is greater than 10000).

$nf$  = the desired sample size when the population is less than 10,000

$N$  = estimate of the Population size

Therefore, on substitution:  $nf = \frac{384}{6001/6000}$

$$nf = 383$$

A total sample of 300 was agreed on at the project evaluation inception together with the project management. However, 318 questionnaires were administered which included 46 non targeted households. The number was increased by 5% to cover anticipated non responses.

### 2.4 Methods of data collection

The following tools were used for data collection;

#### 2.4.1 Document review.

The consultants reviewed various program and related project and baseline research documents. This created a better understanding of the risks households (HH) are exposed to when using cook stoves. Policy documents and scientific publications relating to government interventions in household energy, renewable energy and IAP will be reviewed for relevance and incorporation in the project evaluation report.

#### 2.4.2 Quantitative approach.

This was the main technique used to record the situation and demographic profiles of specific target groups in the study area. A population of 300 respondents was targeted. However, 318 respondents were reached. Out of these 46 were households that were non-targeted for interventions that acted as control. The respondents were interviewed using a pre determined semi structured questionnaire.

The questionnaires were designed to look at among other things, socio-economic data of the households. The socio-economic data of the households included the number of people cooked for in the house, age and sex of household members, education and occupation, expenditure on fuels among others. The questionnaires were administered to community members/study groups who are also stove promoters, installers, users of the interventions, distributors, members of village savings and loan groups.



The purpose of administering the questionnaire was to elicit perceptions of households on energy and health, perceptions of beneficiaries on levels of kitchen pollution, stove efficiency and needs, cooking patterns, fuel substitution, training needs, capability to purchase, availability among others.

Aspects of health impacts from IAP such as coughing, burns, eye irritation were checked with the use of questionnaire discussions and observation. The questionnaire also assessed the level of awareness on IAP and the project. A questionnaire for smoke pollution measurements was developed and smoke measurements taken using the Badge smoke measurement instrument.

### 2.4.3 The qualitative approach

The qualitative approaches included the following;

Key Informant Interviews(KII) which was held with Provincial administration(Location Chiefs), Agriculture department, NGO's such as SCC-Vi Agro forestry staff, VIRED staff, Community Health Workers(CHWs), stove promoters, stockists, installers and community opinion leaders. The discussion guides were used to explore the use patterns of stoves, socio-economic situation, institutional role analysis, availability of stoves and fuels in the division, stove production and effect of smoke on health.

Focus Group Discussions (FGD) were done with stockists, one VSL, a stove production group, school pupils, and primary school teachers. The group discussion approach helped to bring out the extent to which the project had achieved its intended objectives. The discussion with primary school teachers and pupils assessed the extent to which knowledge on IAP has penetrated the society's structure and the project impact on primary school children and teachers. It was expected that the discussions with school communities on project activities would serve to elicit levels of knowledge about the project in relation to social and behavior change among teachers and school children. Field observations and photography were carried out and incorporated into study findings (Plate 1).



**Plate.1: Photo showing a focus group discussion session of SCOREPS from SCI and Location Representatives from PA at former chief Abungu's home in Korowe**

#### **2.4.4 Indoor Air Pollution measurements and monitoring**

The monitoring focused on carbon monoxide reduction levels in the kitchens. A 48 hour monitoring was done for the measurement of quantities of carbon monoxide levels in targeted and non targeted household's kitchens. The measurements were recorded in parts per million of carbon monoxide. One hundred and ten households were engaged in the smoke pollution measurement process. The process was designed to ensure that a mix of households with at least one solar intervention (the solar cookit) in group one and group two with no interventions were used in the monitoring process. The measurement equipment used was *Pro Gas Badge monitor*. The Gas Badge Pro is certified for use within the ambient temperature range of -40o C to 60o C. The primary character display of the instrument presents the time weighted average (TWA) over the last 1 to 40 hours, as set by the user. The TWA reading is accompanied by the PPM concentration indicator and the TWA indicator<sup>12</sup>.

#### **2.5 Data analysis:**

Data was analyzed using excel and SPSS so as to help bring out the relationships. The qualitative data have been analyzed as per the objectives and information used for discussion of results, conclusions and making recommendations.

<sup>12</sup> *Pro Gas Badge Instruction manual*



## **3.0 RESULTS AND DISCUSSIONS**

### **3.1 Background Information of the Households**

A total of 318 households were sampled and interviewed in July 2011 and during the same period a total of 13 focus group discussions and key informant interviews were conducted. This section presents the findings and discussions of the household interviews, focus group discussions, staff interviews and Key Informant Interviews. It also contains obtrusive information that was gathered by the consultant and the evaluation team.

#### **3.1.1 Demographic background**

In the 2009 Kenya population and households' census, Kadibo division had a population of 61,326 persons and 12,994 households. Of this population there were 32,074 females and 29,252 males. This study targeted households, individuals in the community, marketers, distributors, stockists, installers of equipment and interventions, current and potential energy entrepreneurs, users, current and potential stakeholders. The target also included government officers within departments and ministries of Agriculture, Public Health, District development officer, Provincial Applied Technology Officer, and provincial administration. Out of the number of households that were polled 46 were non targeted households that had no interventions. The respondents were drawn from the eight locations in the division.

#### **3.1.2 Household characteristics**

##### **3.1.2.1 Education**

It emerged that 46.2% of the respondents could read easily, 25.2% with difficulty while 28.6% could not read at all. From the analysis of results 16.4% of the respondents had never gone to school or had no formal education while 53.8% had gone through formal education and either completed lower or upper primary level of education, 23.4% had completed secondary level of education. Only 4.2% of the respondents had attained post-secondary education (Table 1).

**Table 1: Educational level of participants**

Education level	Number of respondents	Percent
None	52	16.9
Lower primary	46	14.9
Upper primary	125	40.6
Secondary	72	23.4
Tertiary/college/university	13	4.2

According to the current district development plan for Kisumu district, the dropout rate in the rural areas of the district including Kadibo division stands at 50%<sup>13</sup>. This confirms the fact that 53.8% of household members could only read with difficulty or not at all. Formal education is an important factor that can directly influence awareness about technology and technology uptake since most of the information is passed in languages that are acquired through education. Also the education level can assist a person to read and understand information passed through calendars, flyers or posters even when they are in local languages. When it comes again to technology adoption the dynamics of use it may be difficult to be understood if the beneficiary is unable to grasp the concepts fast. It has been shown on the table above that only 27.6% of the respondents have attained secondary and tertiary level of education, this posed challenge on methodologies of awareness creation and project implementation as majority of the community members were limited by the low level of education they possessed. This result shows that the types and strategies of awareness campaign that were carried out in Kadibo to enable understanding of the effects of smoke to livelihoods needed to emphasise strategies that did not require reading capability especially among villagers. Those that require reading would be more appropriate to those with good basic education and in schools.

### **3.1.2.2 Gender**

The population of Kadibo division is 61,326 individuals<sup>14</sup> and females make up to 52.3% of the population. During the household survey, 96.2% of those who were interviewed were female while the remaining 3.8% were male. This could be simply because the energy issues especially in relation to food preparation in the study community are left in the hands of female gender. In a previous market study by Practical Action in the region<sup>15</sup>, it emerged that the decision on the use of IAP reduction appliances is left in the hands of women. This posed challenges in the project implementation on the fact that women are the economically vulnerable individuals in this society and they hardly earn anything substantial to adequately empower them to meet finances required to purchase stoves so that they can adopt the technology.

Therefore during the project implementation, economic status of the female gender in Kadibo community could have frustrated the uptake of the kitchen smoke reducing technology interventions. In other gender considerations, women were involved in both productive and reproductive activities and sometimes they would become too busy to get time and attend awareness meetings and training/seminars organized in the area especially those who are still at the reproductive age.

<sup>13</sup> Kisumu East District Development plan, 2008-2012; page 108

<sup>14</sup> 2009 Kenya Population and Housing Census Vol. IA

<sup>15</sup> Market study report-Practical Action



However, this project tried a lot to deal with the issue of economic vulnerability among the installers who are mainly women by setting up Village Savings and loaning (VSL) groups. These provided funds to installers inform of credit and made them able to acquire stoves, install and be paid for their services. This is a promising undertaking and had the potential of supporting the sustainability of the project. In future this may call for female empowerment campaign that should involve coming up with Income Generating Activities that may boost economic capacity and empowerment alongside gender equity.

### 3.1.2.3 Household composition

The numbers of children per household were different. Within the division, households with 1-5 children and youth form 48% as those with over six children form only 7%. For the children under five years, 57% of the households have between 1-2 living with them. The number of female is high than the number of male (Table 2).

**Table 2: Household population in the Locations within the division**

Location	No. of males	No. of females	Humber of households	Total population
Kawino North	4 180	4413	1821	8593
Kawino South	3218	3421	1381	6639
West Kochieng	5194	5972	2280	11166
East Kochieng	5259	5767	2377	11026
Kombura	3843	4273	1767	8116
Bwanda	2821	3089	1260	5910
Katho	2826	3127	1288	5953
Kanyagwal	1911	2012	820	3923

The mean age of the household head is 47.29 years while half of the households are headed by individuals aged 45 years and above. The oldest person interviewed was 93 years and the youngest was 16 years. Slightly over 70% of the households are headed by persons under 60 years and who could be described as active workforce below the government retirement age while the median and the mode are both 45 years.

The average household size is 4.72 while the median is 5 persons per household meaning that half of them had a population of 5 and above.

### 3.1.2.4 Household income

As the case is for many rural areas in the country, the communities in the project area are highly dependent on subsistence livelihoods; as such farming is the main economic activity in the area. About 47% of the respondents said that their main source of income is from farming while 36.9% depended on business while 8.6% of the respondents derive their livelihood from salaried employments including teaching (Table 3). The residents were dependent on various forms of agriculture for subsistence; mainly food crop farming, and livestock rearing. Various crops are grown including rice, maize, other cereals and vegetables.

**Table 3: Source of income in Kadibo division**

Source of income	Number	Percent
Teaching	6	2.1
Farming	132	47.3
Trade/business	103	36.9
Other salaried employment	18	6.5
Others	20	7.2

The Kadibo community is not homogeneous groups since there are poor members and more resource endowed households. This is reflected in type of housing and kitchens, number of livestock kept and size of land among others. In order to improve access to the interventions, the implementing institutions especially Solar Cookers International secured extra funding to support provision of Upesi stove and solar cookit to poor and vulnerable members of the community. These members of the community are most likely to have poor kitchen structures and cooking devices. Also with this extra funding, SCI was able to carry out more demonstration and awareness raising activities in the area and beyond.

## 3.2. Awareness Level on the USEPA Project

### 3.2.1 The strategies and methods of awareness creation

In order to change people's attitudes, improve knowledge, level of understanding and education on dangers of smoke on health of mothers and children, several awareness strategies were employed. These included public and group demonstrations, model kitchen as demonstration, radio programs, radio spot announcements, posters, songs and dances, T-shirts, drama and Community Theater, group meetings, newsletters and flyers distribution were employed. One such song that was used by the women involved in the project is hereby quoted below;

A song goes; Mond Solar dier  
ng'ewa sievore ka ring anguro.  
*'Solar ladies our bodies are  
smooth and fat like pork.*



Door to Door awareness and campaign strategy ensured that the community members were engaged in one on one discussion on the dangers of smoke and what needs to be done about it to address the issue of indoor pollution.

Posters were placed at strategic public places and distributed in schools. Posters were observed on school staff room notice boards which keep reminding teachers on the importance of indoor air pollution reduction in kitchens. Within schools community, teachers have been trained in seminars on the effect of smoke in kitchens and they have used this knowledge to teach pupils on the same subject matter during science lessons. T-shirts have been printed by both Solar Cookers International and Practical Action to pass valuable information to potential customers and users of smoke reduction devices.

The live radio discussions on the project activities provided awareness to listeners even from outside the project area. During one such live program, a tracking report shows that one lady Ms. Faith from Mbita in Suba district commented through telephone interaction and asked the question;

*'The smoke effects are already with us and I have a friend who never had asthma but currently is an asthma patient- What do you advise that we do?'*<sup>16</sup>

During the evaluation exercise pupils from some selected schools were included as focus group discussants (Plate 2) and it came out that they quite aware of the USEPA project activities and its health and economic benefits.



**Plate 2: Showing a Focus Group Discussion with pupils of Migingo primary school in Kadibo division**

According to project documents, group education and public demonstrations were only two major viable channels of creating awareness to the interventions, however door to door

<sup>16</sup> Radio transmission monitoring records-USEPA project



campaign was also a possible channel but it was expensive and also hindered by floods during the rainy season in the division. During public demonstration the appliances were put in the open and the project implementers showed the people how they work and the advantages of using them (Plate 3).



**Plate 3: SCI SCOREPS and installers demonstrate use of Solar cooking devices at Rabuor**

During an earlier market baseline study<sup>17</sup>, the investigation came up with the best channels of communication for marketing which showed that 54% of the respondents agreed that the most effective channel is group education as 46% preferred public demonstration for awareness creation. Some entrepreneurs also used the media for example, Radio Lake Victoria, to advertise their products; others had used theater and drama. Display of devices at the jubilee market in Kisumu, Rabuor market, Korowe, Ahero and other public places had been employed while some traders wait for the customers to get information, when they come to buy the cooking devices especially during market days or at home.

The Market day demonstration was used to create awareness to 28.7% of the respondents, through village meetings 19.7% were reached, radio programs as primary source provided information to 11.5% of the Kadibo division households (Table 4). However, Radio Lake Victoria was used to discuss issues of smoke pollution in the kitchen. This station has a listenership of over 3 million people in Nyanza and Western Province. The radio programs were held on a weekly basis for a period of three months. Group demonstrations have been used to inform the community on the use and benefits of the interventions.

By the words of one Installer/locational leader at a demonstration in RIAT market, Kanyagwal; 'Anyisogi gimaber atonga en molooyo to ndalo makoth chwe. Gitedo kaeto gikano e fireless'-Raymax, a PA Locational leader and installer. (I am showing them the benefits of fireless cooker especially in the flooding season as they cook and keep the food warm for longer time in the Fireless cooker)

<sup>17</sup>

Market survey report-Practical Action, 2008



**Table 4: Showing means through which individuals got information on the project activities**

Awareness raising method	Number	Percent
Radio program	18	11.5
Market day demonstrations	45	28.7
Village meetings	31	19.7
Wall poster	15	9.6
Public baraza	7	4.5
Others	41	26.1

In the previous market survey, 91% of the respondents revealed that they were aware of the devices customers use for cooking and actually 9% said they are not aware. Specifically they were aware of improved devices used by customers including Kenya ceramic jiko, Upesi stove, Upesi portable and Uhai jiko. In addition, 86% of the sellers were willing to promote any of the above devices.<sup>18</sup>

### 3.2.2 Institutional roles in awareness creation

During the evaluation 90.8% of the respondents reported of being aware of USEPA project and its activities in Kadibo Division. For the respondents who were aware of the project 34.2% received information from Solar Cookers International, 29% from Practical Action, 5.9% chiefs, 2.6% Ministry of health and Ministry of Agriculture provided information to 1.8% while those who received the information from other sources represented 26.5% (Table 5). Awareness levels were able to be enhanced through culturally popular methods such as use of songs informing people of solar cookits and Upesi stove or smoke pollution reduction during public meetings.

**Table 5: Showing the institutional source of awareness information on the project**

Organization	Number	Percent
Solar cookers international	93	34.2
Practical Action	79	29
Ministry of agriculture	5	1.8
Ministry of health	7	2.6
Chief	16	5.9
Others	72	26.5

The relatively higher proportion (34.2%) of those who received information from Solar Cookers International when compared with other partners could be attributed to location of their office which is right within the community where the beneficiaries reside.

<sup>18</sup> Market research; Entrepreneurs survey-USEPA project

### 3.2.3 Training and seminars organized by USEPA project

A sizeable portion of the respondents representing 35.9% confirmed that they have attended training/seminars organized by USEPA project implementers. For those who have attended seminars/training on energy project, 51% were invited by Solar Cookers International, 42.9% by Practical Action and only 2% and 2.7% were invited by ministries of agriculture and health respectively (Table 6). This indicates that the project was identified with Solar Cookers International and Practical Action rather than government institutions.

*Table 6: Showing the groups/ institutions that organised the training seminars*

Organization	Number	Percent
Solar Cookers International	75	51.0
Practical Action	63	42.9
Ministry of agriculture	3	2.0
Ministry of health	4	2.7
Others	2	1.4

Most of the trainings that were attended in the project area were dwelling on cooking demonstration as confirmed by 68.4%, 17.6% attended training on cooking stove installation and maintenance while the rest constituting 14% attended training on other issues.

The non targeted households who never attended the training provided different reasons, and majority representing 87.4% of the respondents said they were not invited for the training, 5.5% were aware but were always committed while 2.7% and 4.4% were too old and lacked interest respectively.

### 3.2.4 Challenges to awareness dissemination

The weather related disasters, for example flooding were cited as the main problem that affected the implementation process of the project because during the rainy season it would be muddy and presence of flood water would make movement rather difficult. This means meetings, demonstrations and information dissemination would be affected.

In a previous Entrepreneurs survey an analysis of the cost of awareness creation as perceived by the installers showed that the LAP technology awareness channels were faced with challenges whereby 80% of the installers felt the channels are expensive and 37.5% were of the opinion that the devices were also expensive<sup>19</sup>.

Group and market demonstrations were criticized by the respondents to be expensive and time consuming in the context of high transportation rates and expensive demonstration food stuff yet sales are low. Also home visits or door to door visits are viewed to be slow yet rather effective as means of technology uptake rather than awareness. In this method one has to visit one home after another even during the flooding season and this can lead to slow but sustainable uptake or purchase of the interventions.

<sup>19</sup> Market research; Entrepreneurs survey-USEPA project



Awareness was intense at the beginning of the project and these included demonstrations in both primary and secondary schools. Teachers who were in such schools at the beginning of the project are aware of the project activities and they convey this information to their pupils while the newly posted teachers appeared to have little information on the project. This showed in consistent awareness dissemination campaign towards end of the project implementation.

The other challenge to awareness dissemination was inadequate support to the installers in form of transport costs. In wet weather the transport costs are high in the area.

According to an earlier survey on radio listenership, Ramogi radio station is the most listened to with 46% of the respondents tuning to it while the remaining 45% of listeners are shared by the remaining two stations (USEPA project report)<sup>20</sup>. Radio programs are effective for reaching a wider audience, however, there are a number of vernacular radio stations and the listenership varies with people.

The respondents of this community listen much to the radio as a basic source of information with a preference to the three local stations which basically broadcast in the Dholuo language. Awareness creation and kitchen smoke reduction policy dialogue was held in a radio station, Radio Lake Victoria, with listenership of 3 million persons in Nyanza and parts of Western province of Kenya. This dialogue engaged the divisional public health officer in Kadibo who would division and location Chiefs within the Provincial Administration of Kadibo division.

This means that it is only the people tuned into a radio station at a particular time learn about the discussion on smoke reduction. From the baseline market survey it was shown that the community prefers to listen to news but it can be observed that 70% would prefer to listen to local common comedies and not discussions.

Group demonstration can be effective in creating awareness among the community. However, in case of cooking demonstrations people may be interested in tasting the foods cooked and not on the technologies being displayed.

### 3.2.5 Adaptation to awareness creation

The project used a mix of different methods of awareness creation so that limitation due to ability to read and write or listen to specific radio stations could be managed. This has proved to be effective in awareness creation. The message contents in information dissemination have been tailored to depict the benefits of using the smoke reducing intervention.

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<sup>20</sup> Radio program monitoring report- USEPA project

### 3.2.6 Recommendation

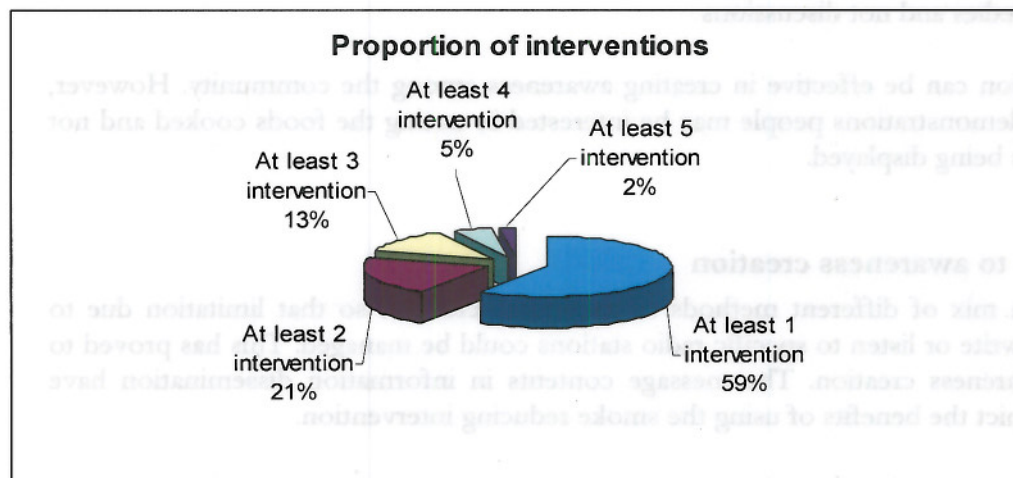
- Awareness would be more effective if it targets school children and uses an integrated approach. This approach would continue to use radios, demonstrations and short films on dangers of smoke to target semi illiterate members of the society

## 3.3 Access, Use and Uptake of IAP Reduction Technologies

### 3.3.1 Access and proportion of interventions in the community

In an earlier Entrepreneurs survey<sup>21</sup>, it was established that only a total of 13 entrepreneurs operating in the division and had been engaged in selling stoves and smoke reduction devices. The results therefore confirm that the number of entrepreneurs have increased from a total of 13 to 86. This represents an improvement in access from 387 household per installer to 140 households per installer. This represents over 200% improvement.

The figure 1 below depicts the proportion of the 272 households with interventions among the respondents visited. Most of the users had Upesi stove as the single most common intervention. The study indicated that at least 41% of those who adopted the IAP reduction technology had more than one intervention. 21% had at least two interventions while 13% had at least three interventions and at least 2% had five interventions. The availability of these quality and tested fuel saving and smoke reducing technologies has increased in the division. In a similar way, there had been an increase in number of stockists for solar cook kits and fireless cookers.



**Fig 1. The rate and proportion of intervention adoption**

<sup>21</sup> Market research; Entrepreneurs survey, USEPA project



The project had away of showing the number of interventions that had been adopted by household. The SCI developed stickers that were used to identify the houses that had installed the interventions in terms of number of interventions. The sticker in the plate 4 shown below is such an example showing that the household had five interventions. These stickers were distributed by the installers and SCOREPS after identifying these houses.

The presence of these stickers in individuals' doors provided some confidence on the part of house owner that they were smoke reduction compliant and sense of belonging to the USEPA project.



*Plate 4: Showing the intervention stickers on a door in one of the kitchens*

### 3.3.2 Use patterns of the interventions

From the response, during the previous market survey most of the users in Kadibo would buy the interventions to save firewood, however, a bigger number would prefer buying them as they save time and money. Households have shown their interest in smoke reduction technology as 46% of the intervention users would buy them to reduce smoke and 8% would buy to keep their kitchen clean. Others would buy because the interventions reduce diseases.

The data analysis during the end project evaluation reveals that 70.4% of the respondents use fuels in the household for cooking and lighting. 98.7% of the community use fuel wood as the main source of cooking energy. Only 6% would prefer using solar for cooking while 95% prefer firewood for cooking. The main reason why people use three stone fire place for cooking is because its perceived to be effective and easy to use. The Upesi stove is a preferred intervention by 95.6% because it produces less smoke. The 6.3% of the people use Uhai stove because of its efficiency in cooking while 70% use it because it saves energy. Solar cook kit is used in the community because 13% says it helps save energy while 10.4% says it saves time and 5.7% indicated that it is not labour intensive and therefore requires less energy.



The research findings on the number of uptake on smoke interventions, it has been shown that the improved smoke pollution reducing devices are gaining popularity in the community. However, some households do not use them consistently. To counter problems related to high prices of IAP technology appliances majority of the entrepreneurs resorted to acceptance of payment by installment by their customers. Mostly customers pay for devices by installments before they pick and collect them after completing the payment.

This is necessitated by the fact that most customers rely on cash from harvest which is seasonal. This method of payment has improved uptake of even the more expensive interventions. The stove installers also work as stockists within the villages and this makes the use of improved IAP technologies in the village to prosper. The findings show that 58.9% of the respondents in the survey felt that that interventions are very useful ( Table 7).

**Table 7: Showing the level of assessment of the impact of installed indoor air pollution devices by the respondents**

Level of assessment	Number	Percent
Extremely useful	105	38.9
Useful	159	58.9
Not very useful	1	0.4
No changes	1	0.4
Not able assess	4	1.5
Total	270	100

### 3.3.3 Limitations of usage of smoke reducing technologies

The respondents were asked on what they consider to be the disadvantage of using the specific smoke reducing technologies. It is noted that most respondents were undecided as to what to the possible disadvantages on usage are. This means that they consider these devices to be more of benefit to users than having some disadvantages (Table 8).

**Table 8: Technology uptake showing the identified limitations in usage of technologies**

Disadvantages	Upesi	Uhai	Solar cook kit	LPG
Undecided/Do not know	67.30	74.2	75.2	81.1
Consumes to much fuel	1.2	1.2	0.3	0.6
Produce to much smoke	0.9	0.9	0.0	0.3
Labour intensive	1.5	0.3	1.2	0.0
Less efficient in cooking	0.9	1.9	2.2	0.3
I don't know to operate	0.0	0.3	0.3	0.0
Others	22.3	22.3	21	18.2
None	6.9	0.0	0.6	0.0
Total	100.0	100.0	100.0	100.0



The technology uptake has shown improvement. The IAP technology appliances installed, households improved and visited between January 2009 to May 2011 has been documented<sup>22</sup>. At least 5,714 households were reached in Kadibo Division and this represents 95.3% of the targeted (6000) households which is 44% of the total number of households in Kadibo Division. These were reached by at least one set of effective interventions that was being promoted. This set of interventions that is termed as “effective” refers to the combination of the Upesi stove stove and improved ventilation in the kitchen by means of an added window or new or increased eave spaces. A previous Practical<sup>23</sup> study revealed that this was the minimum set of interventions required to effectively reduce IAP by levels of upto 60% from the kitchen environment.

During the evaluation, secondary information showed that there have been a lot of dynamics in terms of installers’ numbers per month from the project inception time up to its end. Across the same period there have been 634 numbers of installers working and trained in accumulation who have worked in the area bringing an average of 22 installers per month. Up to that time 4063 IAP appliances had been installed and out the number 73% were Upesi jikos, 12.7% Kenya Ceramic jiko, 6.8% Upesi portable, 4.4% Fireless cooker and 0.7% solar cook it.

Due to intense implementation effort by Practical Action and Solar Cookers International, by the end of the project in June 2011, 85% of the respondents revealed that they have knowledge on the use of the interventions. This is supported by the high levels of awareness which was above 91%. However, it should be noted that 15% still have no knowledge in the use of the interventions despite the fact that they know the importance of these devices.

The respondents to the questionnaires gave varying responses regarding their reasons for installing any smoke reduction device in their kitchen in the last three years. The reasons include the fact that the interventions saves firewood, saves time during use, saves money, reduces smoke, make the kitchen clean and ensures safety of the kitchen user (Table 9).

**Table 9 : A summary of the reasons for purchase of interventions**

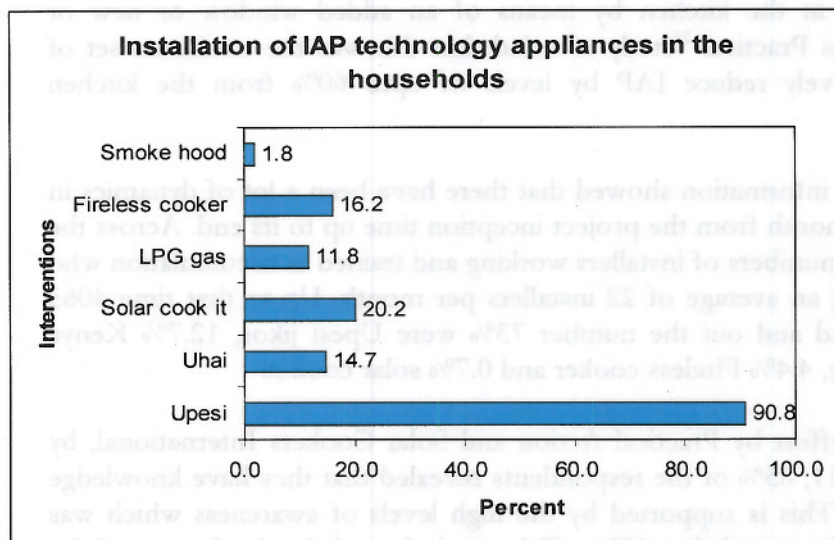
Reason for purchase	Percentage
Saves firewood	85
Saves time	69
Saves money	62
Reduces smoke	46
Make the kitchen clean	8
Because of safety	38

The reasons why safety was considered as an important component of purchasing the interventions included protection from burns and prevention of eye problems among others.

<sup>22</sup> Project records

<sup>23</sup> Practical Action - Scaling Up Pathways to Sustainable Kitchen Smoke Alleviation, 2004-7.

The results show that 90.8% said they have installed Upesi stoves, 14.7% had installed or purchased Uhai stove, 20.2% had bought and use Solar cook kits, 11.8% had purchased LPG gas, 16.2 % had installed Fireless cookers while 1.8% had constructed smoke hoods or eave spaces (Fig 2).

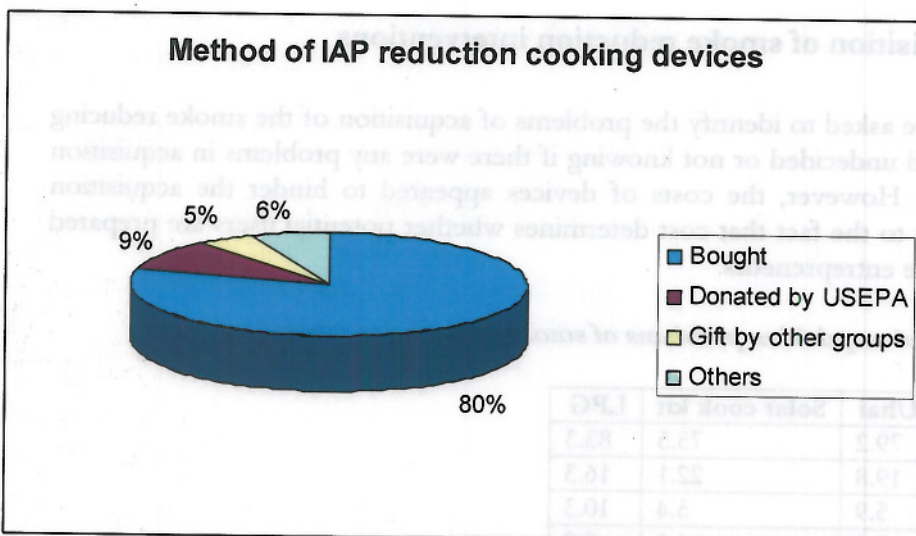


**Fig 2: showing the proportion of IAP technologies installed in the division by June 2011**

### 3.3.4 Mode of acquisition of interventions

The users of smoke reduction technologies acquired the devices in various ways. For the respondents, 81.6% bought the interventions, 9.6% of the users received the interventions as donations from the partners in the USEPA project while 5.1% received the devices in form of gifts from relatives, sons, daughters and friends. About 6.6% of the users acquired the interventions from other sources (Fig 3). It has been reported that the other sources were institutions that include churches and Center for Disease Control (CDC), a locally operating organization which also gave some interventions especially Upesi stove in the division. The mode of acquisition of the devices is a reflection of access of the smoke reduction technologies in the division since they could be easily bought by most individuals (80%) , this reflects higher levels of access.





**Fig 3. Modes of acquiring IAP reduction technology appliances**

### 3.3.5 Limitations to uptake of interventions

The uptake of technologies has been slowed down for various specific devices for different reasons. The common factor limiting uptake is price which the respondents agree is rather high for their income levels. The product quality does not seem to be a significant factor in limiting uptake, a factor that shows that the interventions were of good quality and standards could have been ensured during production (Table 10).

**Table 10: Showing the most important factors limiting the uptake of smoke reducing Technologies in Kadibo division at end of project.**

	Upesi	Uhai	Solar cook Kit	Biogas	LPG	Hay basket or Fireless cooker	Smoke hood	Others
	%	%	%	%	%	%	%	%
Price	54.3	49.1	59.7	0.0	53.2	57.8	50	66.7
Availability	8.7	9.1	5.2	0.0	8.5	4.7	10	7.1
Product quality	2.8	1.8	2.6	0.0	2.1	1.6	0	0.0
Lack of knowledge on use & maintenance	32.2	38.2	32.5	0.0	34.0	34.4	40	26.2
Others	2.0	1.8	0.0	0.0	2.1	1.6	0	0.0
	100.0	100.0	100.0	0.0	100.0	100.0	100	100.0

### 3.3.6 Problems in acquisition of smoke reduction interventions

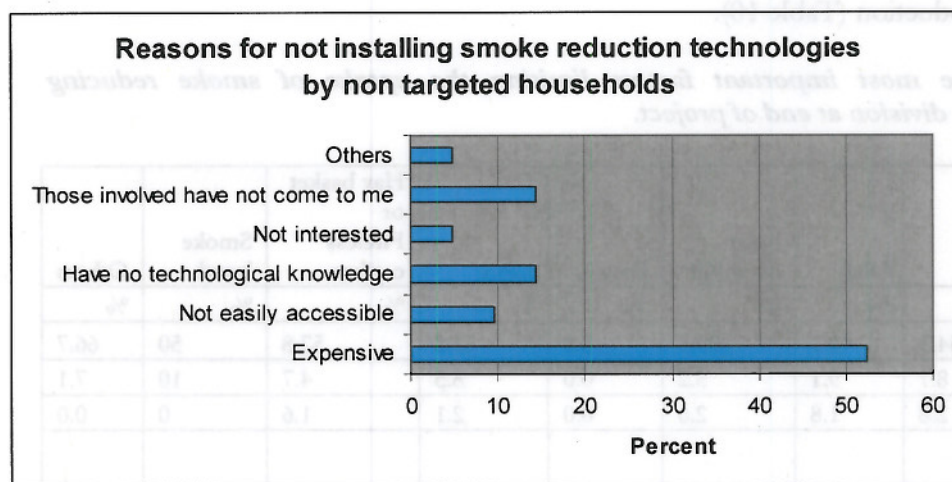
When the respondents were asked to identify the problems of acquisition of the smoke reducing technologies, they appeared undecided or not knowing if there were any problems in acquisition of the devices (Table 11). However, the costs of devices appeared to hinder the acquisition process. This could be due to the fact that cost determines whether potential users are prepared to discuss any sales with the entrepreneurs.

*Table 11: Showing identified acquisition problems of smoke reducing technologies*

Problem	Upesi	Uhai	Solar cook kit	LPG
Undecided	61.0	79.2	75.5	83.3
Expensive to buy	32.3	19.8	22.1	16.3
Not easy to get	10.0	5.9	5.4	10.3
Have no idea	0.6	3.1	1.6	8.8
Other reasons	0.9	0.0	0.3	0.0
Total	100.0	100.0	100.0	100.0

### 3.3.7 Reasons for non-involvement by non-targeted households

The non targeted households were asked why they did not install the smoke reducing devices even though they resided in the project area. Over 50% did not install them because they felt they were expensive and 30% said they did not install because the installers did not go to them (Fig 4). The non visit by installers could be due to the fact that there are still large populations that are not served by installers and which require more installers to be trained.



*Fig 4. Reasons for not installing smoke reduction technologies by non targeted households*



### **3.3.8 Challenges to adoption of IAP technology**

The adoption of intervention devices face a few drawbacks which were mentioned by the users, installers/entrepreneurs and key informants. In general it was agreed that uptake has been rather successful, however, the following set backs were observed;

- The most noted challenge is the price of the interventions that was said to be rather high for the households. This is combined with the fact that some of these interventions are not easily available in the villages. Specifically, Smoke hoods are not easily available because they are only accessed from the smoke hood artisans.
- The materials for making Upesi stoves are still being sourced far off the division in a neighbouring division. This may limit stove supply by local producers if logistical arrangements for sustaining material supply are not put in place.
- The most mentioned was the fact that the interventions cook for very few people and this is supported by the fact that most of the households cook for more than five people
- Technically they said the ports which the customers have are not friendly to the solar cookIt.
- Some interventions like solar cookIt require attention for a long time when cooking as you cannot let it lie unattended in a home when other members of household are not there. Also fireless takes longer time to cook food. This may make the food to go bad after taking too long in the basket.
- In Kadibo Division, it was noted that the community is characterized with very low income levels which reduce their purchasing power.
- In Kadibo division, quite a number of the people do still have a negative attitude toward the use of the interventions given the fact that 31% felt the community still relies on traditional cooking practices. In a number of the households with interventions it was observed that the three stone fire place was still maintained even though they may not have been in active use.
- Another technical issue is the fact that installation and fabrication materials for Upesi jiko (Muram and Ant Hills), baskets, and vermiculite or rice husk ash for fixing Uhai stove are not easily available in the division.

### **3.3.9 Coping strategies adopted on the challenges by the beneficiaries on adoption/uptake**

In response to the challenges especially high prices the majority of the entrepreneurs have now resorted to accepting payment by installment by their customers. Mostly customers would pay for devices by installments before taking hold it. This is necessitated by the reason that most customers rely on cash from harvest of farm produce which is seasonal and marginal. The

problem of pricing resulted into the reduction of cost of purchase and installation of Upesi stoves from KShs. 350 to a lower KShs.300.

A number of community members especially installers and women in particular have joined Village Savings and Loan groups where they can obtain credit for purchase of interventions. Others have resorted to exchanging devices especially the expensive ones like LPG gas with other goods other than cash for example, grains, sheep and goats, chicken and other livestock among others.

The process of product value chain addition is apparent in the community. The installers in particular are improving the quality of their products by fixing stove liners into claddings so as to improve lifespan and portability as well as cost for improved income. This they do mainly for Upesi portable and Uhai jiko. They also source production materials for fireless cooker and use them to make the device at reduced prices.

The cost of transportation is a hindrance and has made some installers and entrepreneurs to resort to using their bicycles as an alternative cheaper means of transport. The production of stove liners has also been taken up by an active women group, *Bed gi Kwe women group* within the division (Plate 5).

On the other hand, they felt adoption will succeed given that customers feel that using intervention devices improves the taste of food and solar cooking promotes cleanliness in a cooking place and that of food. The stove entrepreneurs have specialized in using solar cooking especially for producing wedding cakes for local church weddings within the community. In fact there are users who are now known as suppliers of solar cooked cakes for weddings.

These coping strategies that were employed by stakeholders and beneficiaries are positive pointers towards the success of the intervention. They clearly demonstrate the likelihood that these interventions can be sustainable since most of these coping strategies involved application of local knowledge and use of locally available resources.





**Plate 5: Photo showing members of BED GI KWE women group-a Stove liner production group at work at their workshop in Nyang'ande in Kadibo division**

### **3.3.10 Recommendation**

The current ratio of one installer per 140 households shows that access is still limited. The project implementers would look at possibility of continuous training of more installers, stockists and other entrepreneurs to improve access to smoke reducing interventions

## **3.4 Household Health and Livelihood**

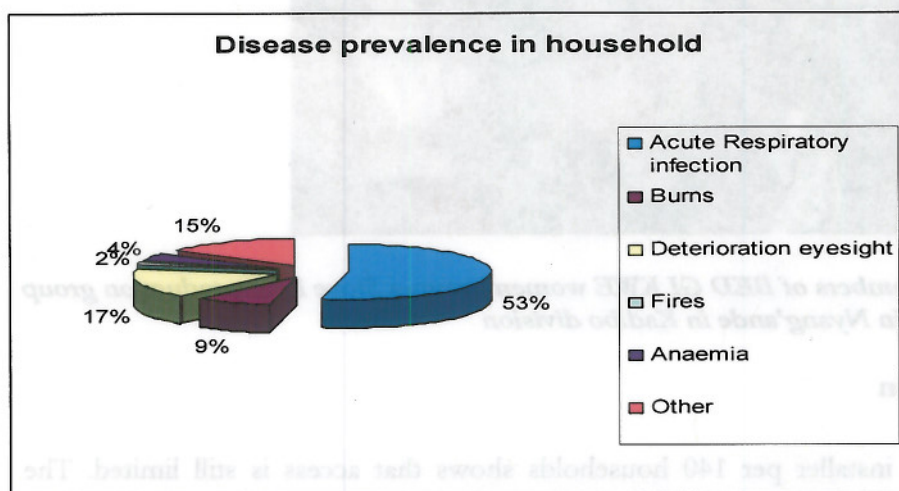
Respondents to the questionnaire gave varying responses regarding the general trends in community health without considering malaria, 51.0% alluded that both lower and upper respiratory diseases were the most common in the area followed by diarrhea at 4.8%, cholera was at 1.1%. Other diseases that were also identified counted for 46.8%. During this study majority (50.7%) of the community members described the respiratory diseases to be frequent, 28.1% said these diseases are fairly frequent while 9.5% confirmed that the diseases are very frequent however, 11.8% said they did not know the trend of these diseases in the community. In the validation meeting with community and stakeholders consultation including the Division Public Health officer, it was observed agreed that respiratory diseases are among the most common diseases in the area along side malaria, diarrhea and skin diseases. However, the incidence of respiratory diseases is lower than malaria as ranked by the public health department at the division for both adults and young children<sup>24</sup>.

During the study it was evident that 83% of the households in the project area had at least suffered from no less than one disease before the study. The majority representing 53% of those who were affected suffered from acute respiratory infection, 17% suffered from deterioration of eyesight while 8.7% suffered burns of various natures (Fig 5). The existence of respiratory

<sup>24</sup> Report and Discussion with Divisional public health officer, Kadibo

diseases was recognized in earlier studies in Kenya. During studies that were conducted earlier symptoms of cough and phlegm were common, and some reported that these respiratory symptoms were chronic, persisting for at least 3 months per year, for the last two years before the project (Practical Action, 2007).

Some women reported at least one episode of illness with cough and phlegm lasting 3 or more weeks at least one year and others had experienced such episodes for 2 years or more before the project.



**Fig 5. Disease prevalence in household**

The results show that a majority of the households representing 54.1% attributed high prevalence of respiratory diseases in the area to too much smoke in the house during preparation of meals while 43.4% ascribed the high incidence to too much dust.

It was also noted that climate changes could be blamed for high disease prevalence in the area as indicated by 44.7%, however, 9.1% did not know contributor to high prevalence of these diseases (Table 12).

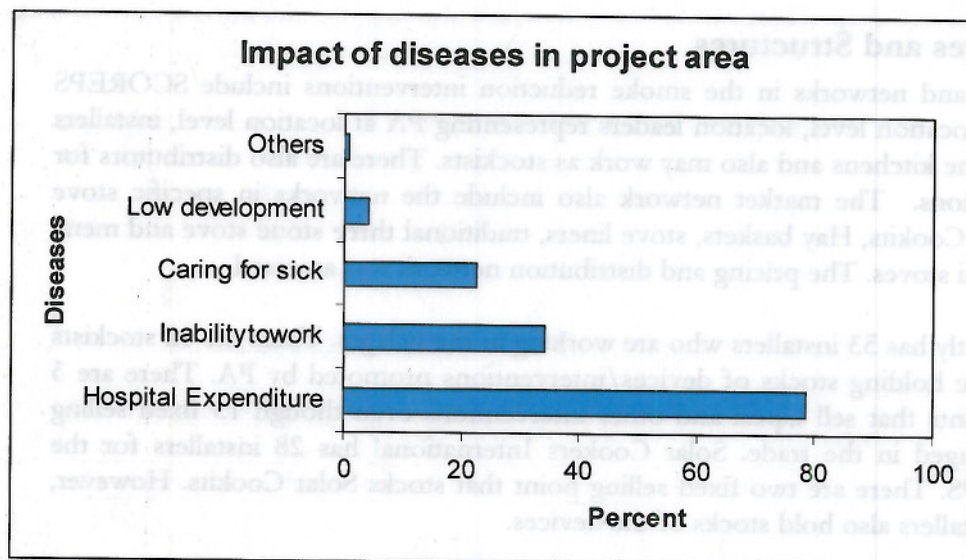
**Table 12: Showing frequency of disease causing conditions in the area**

Disease causes	Frequency	Percent
Poor hygiene	84	26.4
Too much smoke	172	54.1
Too much dust	138	43.4
Climate changes	142	44.7
Do not know	29	9.1



The potential dangers of smoke pollution have been clearly demonstrated during smoke measurements where the recommended threshold was passed especially during the peak hours of cooking.

The occurrence of diseases has impacted negatively on the livelihood of the residents with majority (78.6%) citing increased expenditure on hospital bills, 34% alluded that diseases have held them back from working in their farms. The prevalence of diseases has also increased loss of man hours as most people use most of their times caring for the sick, a fact that was confirmed by 22.6% (Fig. 6).



**Fig 6. Impact of diseases in project area**

During the study 48% (154) of the respondents said that they have put in place various measures to avoid recurrence of health problems in their households. About 39.6% have resorted to use of energy efficient stoves, 19.5% have proper preparation of fuel source while 9.7% have put adequate eve spaces in the kitchen (Table 13).

**Table 13: Showing the measures taken to reduce smoke pollution**

Measures	Number	Percent
Put adequate eve spaces in the kitchen	15	9.7
Provision of a smoke hood in the kitchen	3	1.9
Proper preparation of fuel sources	30	19.5
Using energy efficient stoves	61	39.6
Others	43	27.9

Majority in the study area representing 41.4% reside between 1 to 2 Km away from the nearest health facility, 35.2% reside between 3 to 5 Km, 17.6% are within less than 1 Km from the facility. It was also noted that 5.5% of the residents are staying more than 5 Km from the

facility, however, 0.3% did not know how far away the health facilities are situated from their households. The shorter distance between the households and health facilities can be attributed to upcoming facilities which have been supported by the Constituency Development Fund (CDF).

### 3.4.1 Recommendation

In order to increase understanding of dangers of smoke to mothers and children in a scale up activity, awareness seminars should be organized to target young women in reproductive age as well as grandmothers who take care of orphaned children

## 3.5 Market Linkages and Structures

The market hierarchy and networks in the smoke reduction interventions include SCOREPS who represent SCI at location level, location leaders representing PA at location level, installers who fix the stoves to the kitchens and also may work as stockists. There are also distributors for these energy interventions. The market network also include the networks in specific stove products such as Solar Cookits, Hay baskets, stove liners, traditional three stone stove and metal clad Ugesi and Uhai stoves. The pricing and distribution network was assessed.

Practical Action currently has 53 installers who are working in the villages. There are 12 stockists in the division who are holding stocks of devices/interventions promoted by PA. There are 3 active fixed selling points that sell Ugesi and other interventions even though 13 fixed selling points have been engaged in the trade. Solar Cookers International has 28 installers for the stoves and 8 SCOREPS. There are two fixed selling point that stocks Solar Cookits. However, the SCOREPS and installers also hold stocks of the devices.

The study confirmed that the majority of those in the business of selling indoor air pollution interventions have been in the business for up to three years as they form 54% of all the sellers revealing an increasing population of traders. 31% have been selling for upto 5 years with only 15% who have more than five years in the business.

The main stove distributors and suppliers in the area are installers who were mentioned by 79.6% of the respondents and this was followed at a distance by the SCOREPS and location leaders at 7.8%. Project offices supplied only 1.1% of the households that benefited from the stove installation (Table 14). However, SCI project office was the main supplying project office.

**Table 14: Showing the number of implementers of project in market chain**

Distributor	Number	Percent
The SCOREPS	21	7.8
Shops	13	4.8
Installers	214	79.6
The project office	3	1.1
Others	18	6.7



The study showed that 88.6% of households in the area knew of at least existence of a market linkage of IAP technologies and local users in their villages. At the same time 89.2% of the respondents acknowledged that market network has been developed in the area for IAP technologies.

These business people sell various kinds of indoor air pollution reduction interventions. In their lists Upesi portable and Upesi jiko are the biggest movers while Solar cook it least dealt in with 8% entrepreneurs stocking it. Smoke hood shows a great increase in use as it competes favorably with Upesi Jiko. The table 15 below details them.

**Table 15: Types of intervention**

Type of Interventions		% age sellers
1	Upesi jiko	54
2	Solar cook its	8
3	LPG gas	15
4	Smoke hood	46
5	Fireless cooker	23
6	Upesi portable	85
7	KCJ	15

### 3.5.1 Market location and Customers

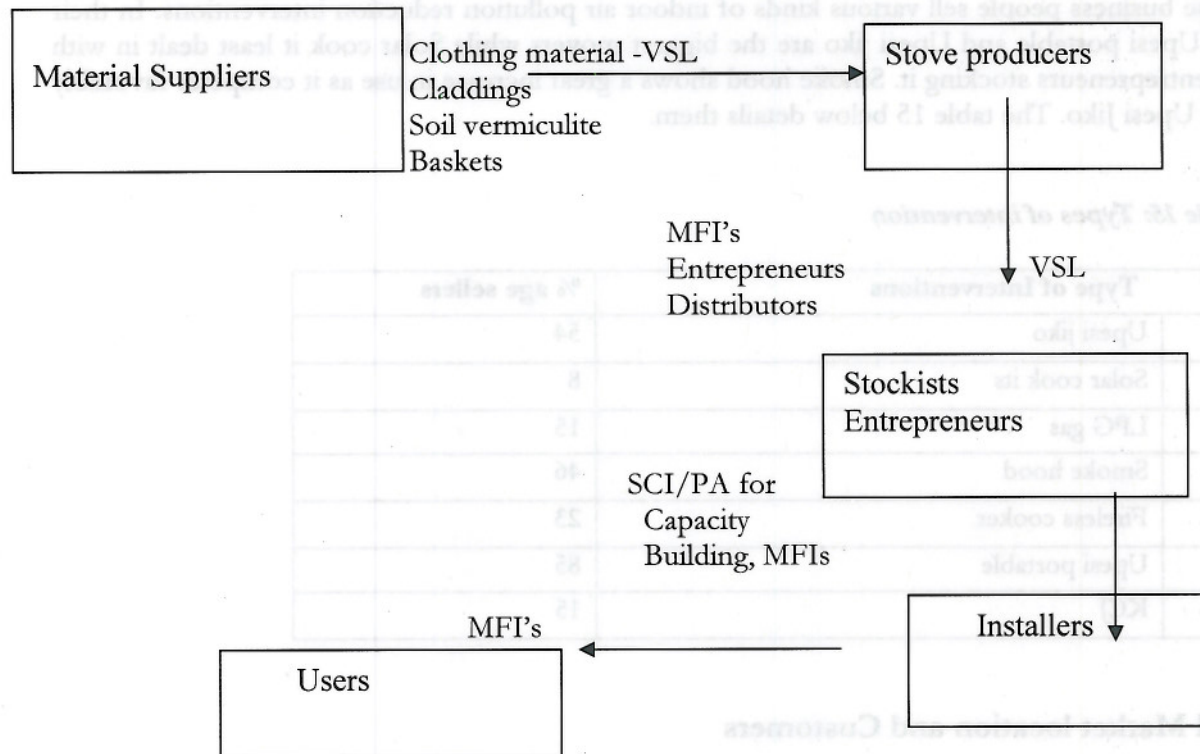
The customers are spread within the locations across Kadibo division as well as those coming from outside the division for example, Siaya, Ugenya, Yala, Kisumu, Nyakach, Muhoroni and Kisii. The customers from outside the project area have been reached through individual initiatives by the entrepreneurs or installers.

### 3.5.2 Market structure

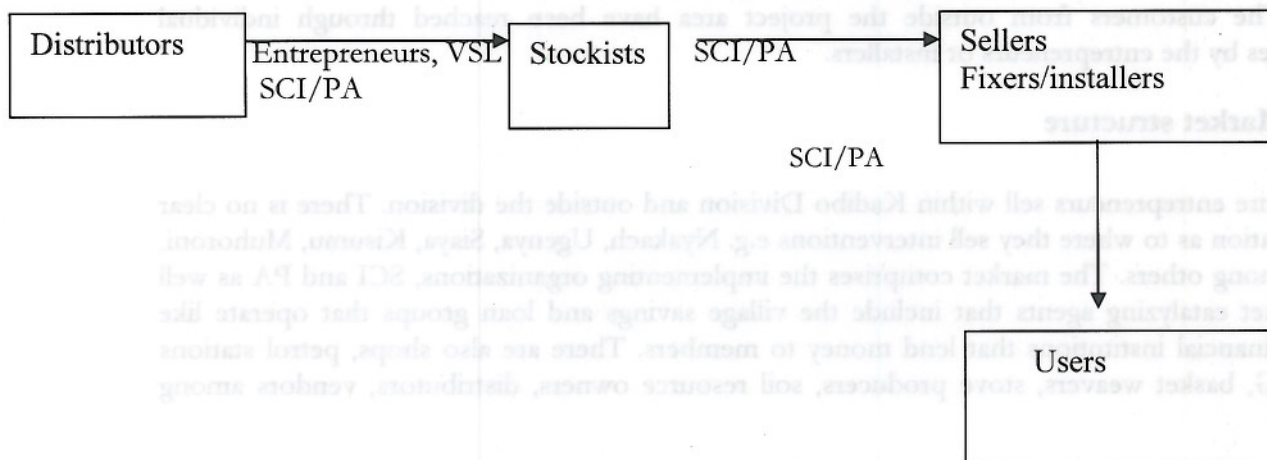
The entire entrepreneurs sell within Kadibo Division and outside the division. There is no clear demarcation as to where they sell interventions e.g. Nyakach, Ugenya, Siaya, Kisumu, Muhoroni, Kisii among others. The market comprises the implementing organizations, SCI and PA as well as market catalyzing agents that include the village savings and loan groups that operate like micro financial institutions that lend money to members. There are also shops, petrol stations for LPG, basket weavers, stove producers, soil resource owners, distributors, vendors among others.

These are linked in a supply and distribution chain that is schematically shown below.

**a) Upesi, Uhai, Fireless cooker**



**b) Market Structure LPG GAS, LAMPS, SOLAR COOKKITS**



**Fig 7. Market structure for interventions**



### 3.5.3 Recommendation

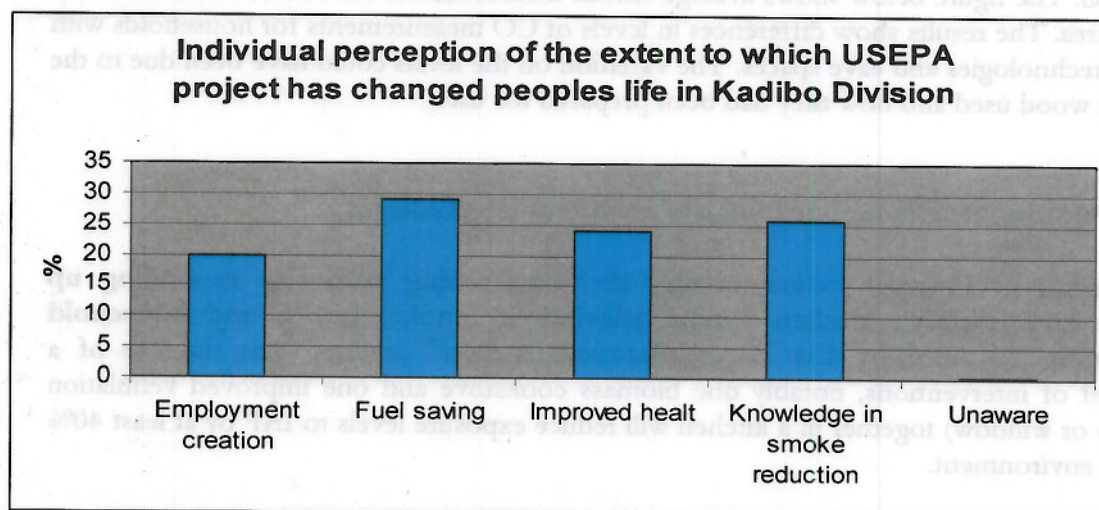
- The VSLs should be encouraged to formalize their existence with government departments as they provide new ways of financing the uptake of technologies and interventions
- More stove and other intervention producers, installers, stockists and fabricators should be trained in the division to ensure a secure supply chain establishment. This would also lead to a reasonable pricing system.

### 3.6 Project Monitoring and Evaluation

Only 32.1% of the respondents confirmed that they have attended a project review meeting while 67.9% did not attend any review meetings. Review meetings are expected to be attended by project implementers and beneficiaries may be invited to attend such meetings.

#### 3.6.1 The observed situations in visited households

Evidence of smoke pollution was observed in 33.3% of kitchens (cooking places) of the households that were visited during the survey and only 4.1% of them had fixed smoke hood in their kitchen. About 58 % of households had created eave spaces in the kitchen, 97.5% had walled kitchen while 85.5% had constructed kitchen that is separate from the living shelter. Three stone cooking structures were existing in 50.3% of the households that were surveyed while 83.3% had installed IAP facilities. This indicates that even those who have installed IAP stoves are still using three stone stoves.



**Fig 8. Perception of the extent to which USEPA project has changed people perception**

### 3.6.2 Observed items that exist in visited households

The types of interventions that were observed at the households were identified. The table below summarizes the observations;

*Table 16: The observed conditions in the kitchen*

Observation item	Number	Percent
Smoke pollution	105	33.3
Smoke hood	13	4.1
Eave spaces	186	58.5
Existence of Kitchen wall	310	97.5
Separate kitchen	272	85.5
Three stone	160	50.3
Installed IAP	265	83.3

### 3.6.3 Monitoring of smoke levels in the kitchen

The Carbon monoxide measurements ranged between 2ppm -8ppm. However, there were a few overshoots of as high as 59 ppm in a targeted household, which could be due to the fact that the household had a cow dung fireplace near the kitchen door and this could have influenced the readings. These measurements are below the WHO maximum threshold(10-20ppm) and current American Occupational Safety and Health Administration (OSHA) permissible exposure limit for carbon monoxide of 50 parts per million (ppm) in an 8-hour time-weighted average concentration. The figure below shows average smoke measurements for selected households in the project area. The results show differences in levels of CO measurements for households with at least two technologies and eave spaces. The variation on the levels could have been due to the types of fuel wood used and how they had been prepared for use.

#### Sample monitoring results for one household without interventions

Previous studies by Practical Action, notably the **Researching pathways to scaling up sustainable and effective kitchen smoke alleviation: Smoke, health and household energy-Volume 2;Edited by Liz Bates; Practical Action**<sup>25</sup> revealed that the use of a minimum set of interventions, notably one biomass cookstove and one improved ventilation (eave spaces or window) together in a kitchen will reduce exposure levels to IAP by at least 40% in the living environment.

Two households are here-below compared on the basis of the monitoring information generated during the month of June and July 2011<sup>26</sup>. Household identifier **EL161908** located in **KAWTNO NORTH**, village **NGONG** and monitored between June 16<sup>th</sup> and 17<sup>th</sup>, 2011. The monitoring started at 19:08hrs in the evening when the household was cooking its evening meal and terminated the following day at 19.11hrs. The household used a three stone fire indoors as the

<sup>25</sup> Period 2004-7.

<sup>26</sup> The full data gathered is available on request